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The Soul of  
the White Ant



EUGÈNE N. MARAIS

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The Soul  
of the  
White Ant

*With a biographical note by his son.*

*Translated from Afrikaans by Winifred de Kok.*

OSIRAN

## THE SOUL OF THE WHITE ANT

by Eugène N. Marais

First published in Afrikaans under the title  
*Die Siel van die Mier*

Originally published in 1937.

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## ORIGINAL PUBLISHER'S NOTE

**E**UGÈNE MARAIS was born in a farming community near Pretoria in 1872. Journalism was his first career, but he later studied law in London, and by 1910 was in Johannesburg trying to establish himself as an advocate. Increasing depression finally drove him to retreat to Waterberg, a mountain area in northern Transvaal.

Settling near a large group of chacma baboons, he became the first man to conduct a prolonged study of primates in the wild. It was this period that produced *My Friends the Baboons* and provided the major inspiration for *The Soul of the Ape*.

He returned to Pretoria to practise law, to resume his career as a journalist, to continue his animal studies and to write poetry in Afrikaans.

In 1926, the year after he had published a definitive article on his original research and conclusions about the white ant, a world-famous European author took half Marais's life-work and published it as his own. This plagiarism may well have been a major factor in Marais's final collapse.

Plagued for many years by ill-health and an addiction to morphine, he took his own life in March 1936.

## ORIGINAL TRANSLATOR'S PREFACE

THE NAME OF EUGÈNE N. MARAIS is known to all Afrikaans-speaking South Africans as a writer of short stories and verse. He himself, however, would wish to be remembered for his lifelong study of termites and apes. He began his working life after leaving college as a journalist, then studied medicine for four years, but eventually took up law.

A scholar and a man of culture, he chose nevertheless to live for a period extending over many years in a 'rondhavel' or hut in the lonely Waterberg mountains, learning to know and make friends with a troop of wild baboons, whose behaviour he wished to study. He tamed them to such a degree that he could move among them and handle them without any fear or danger to himself. At the same time, he also examined the other end of the chain, and studied termite life. This was a study which often meant tremendous hard work and needed endless patience.

During those years, Eugène Marais was not concerned with any sort of publicity. However, a friend persuaded him to write an article for the Afrikaans periodical *Die Huisgenoot*. This proved so popular that the author was besieged with requests for more research information. The articles continued for almost two years.

His years of unceasing work on the *veld* led Eugène Marais to formulate his theory that the individual nest of the termites is similar in every respect to the organism of an animal. He observed that the workers and soldiers resemble red and white

blood corpuscles, while gardens with fungus are the digestive organ. The queen functions as the brain, and the sexual flight is similar in every aspect to the escape of spermatozoa and ova.

About six years after these articles appeared, Maurice Maeterlinck published his book *The Life of the White Ant*, in which he described the organic unity of the termitary and compared it with the human body. This theory created great interest at the time and was generally accepted as an original one formulated by Maeterlinck. The fact that an unknown South African observer had developed the theory after many years of extensive labour was not generally known in Europe.

Excerpts from Marais's articles had, however, appeared in both the Belgian and the French press at the time of their publication in South Africa. Indeed, the original Afrikaans articles would have been intelligible to any Fleming, for Afrikaans and Flemish are very similar.

No one who reads this book, based on the articles published so many years earlier than Maeterlinck's book, would hesitate to give its author the honour due to him.

Eugène Marais intended writing a fuller and more scientific volume, but this intention was frustrated by his untimely death.

– *Winifred de Kok (London, 1937)*

## EUGÈNE N. MARAIS

*A biographical note by his son*



**E**UGÈNE NIELEN MARAIS was born on January 9, 1872 in Pretoria. He was the son of Jan Christian Nielen Marais of Stellenbosch, who traced his descent to a Charles Marais, a French Huguenot. Into this family had married Baron van Rheede van Oudtshoorn, who had been sent out to be Governor of the Cape but had died on board ship in Table Bay, and Dr. Nielen, an American doctor who had come out to South Africa.

Eugène Marais received his first definite schooling in English from an Archdeacon Roberts in Pretoria in whose school he won a 'prize for divinity' because he could recite the whole of the Catechism of the Church of England. After a journey by ox-wagon through the bushveld he was taken to Boshof in the Orange Free State, where he again went to an English school and later to the Paarl.

At the end of the 1880's he was back in Pretoria, and in a few years seemed definitely to have adopted journalism as

his profession. At first he was a parliamentary reporter of the Volksraad, but because of his caustic comments on the proceedings he had the distinction of being expressly excluded from the press gallery by a resolution of the Volksraad.

He became Editor of various papers, both English and Dutch, and his whole-hearted support of General Joubert against Kruger resulted in his being tried for high treason, on which charge he was acquitted by the Supreme Court in Pretoria. During this period of his residence in Pretoria he showed great interest in animals and insects, and was never without tame apes, snakes, scorpions, and the like.

In 1894 he married Miss L. Beyers in Natal, but she died the following year. The loss of his wife had a profound effect on him, and accentuated the sombre side of his nature which had already occasionally clouded an otherwise bright-spirited temperament.

In 1895 he left Europe with the intention of studying medicine, but he was persuaded by friends in the Transvaal to take up law. He made the change, much to his subsequent regret, and at the Inner Temple in London qualified as an advocate. He studied medicine at the same time, however, and only the Boer War prevented him from qualifying. He was on parole in England during the Boer War until the opportunity presented itself of going on an expedition to Central Africa, from where he intended to take medical supplies and explosives which he had collected to the Boer Forces across the Limpopo.

While still in Central Africa, where he contracted a severe case of malaria, he learned of the conclusion of peace in 1902. The stores and supplies were buried, and he returned to Pretoria via Delagoa Bay. During his travels he had added greatly to his store of knowledge of the habits of insects and animals.

In Pretoria he began to practise as an advocate, and produced a book on Deeds Office practice. He was still interested in his newspaper *Land and Volk*, for which he wrote in what was considered 'Afrikaans'. His poem *Winter Nag* heralded the

new Afrikaans movement.

In 1910 Marais went to Johannesburg, where he again practised as an advocate, but his distaste for the work, coupled with increasing depression, made him give up his practice and move to the Waterberg district.

There, he made an intensive study of birds and beasts. There was no natural phenomenon which escaped his eager mind. He wrote an article for the Government Agricultural Journal on the drying up of Waterberg which was reproduced by the Smithsonian Institute in their annual report. At the same time he was contributing articles on snake poison and stories to the Afrikaans press.

In the district he freely gave of his medical knowledge to help the poverty-stricken population, and acted for years as Justice of the Peace.

But by the end of 1915 his health was so bad that he had to have careful attention, and he was taken to Pretoria, with the happy result that after some months he was able to resume his practice as an advocate. He had chambers nearby and was a close friend of the late Mr. Tielman Roos.

There was again a period of literary activity, but constantly failing health made him give up his practice. There followed a period of practice as an attorney at Bronkhorstspuit and Heidelberg in the Transvaal.

By this time he had completed the draft of what he hoped would be his chief work, *The Soul of the Ape* – a study of the behaviour of apes and baboons and the comparison of their mental processes, as far as these could be gauged, with those of man.

His delight now was to use the newly-fledged Afrikaans as a medium of expression, and the opening it offered for the introduction of new words and modes of expression was eagerly seized by him. While poems, stories and articles flowed from his pen for newspapers and magazines in Afrikaans, he also contributed to English scientific journals in English.

In 1928 another breakdown in health brought him to Pretoria, where he kept up his journalistic work and endeavoured to give form to his work on the termites and ants. There is much that he would have added and possibly much that he would have corrected in this present work, had his health permitted him to give undivided attention to the work. But it was not to be, and on March 29, 1936, he committed suicide on a farm near Pretoria.

Of a singularly pleasant nature, he was adored by and adored children, and especially in his later years could almost always be found in their company.

He has a clear and assured niche among the most noted writers in Afrikaans, and his scientific work and theories written in English have received special notice in America and Europe.



THE SOUL OF THE WHITE ANT



# The Beginning of a Termitary

SOME YEARS AGO, an article about 'white ants,' as termites are commonly but incorrectly called, appeared in a South African journal. Almost everything that naturalists tell us about these insects is important and interesting, and Dr Hesse's article was exceptionally so. The article also made another fact clear; how very little has been done in our country to study the behaviour of animals. Nevertheless, a lot of research has already been done and is still being done in other countries. Everything that Dr Hesse told us was the result of long and patient observation in America and Europe. None of his facts, however, were relevant to our South African termites.

The life-history of most of our South African ants and termites is in every way just as wonderful and interesting as anything that has been discovered in South America. Over a period of ten years, I studied the habits of termites in an investigation into animal psychology. Such observation reveals new wonders every day. To mention one instance, the functioning of the community or group psyche of the termitary is just as wonderful and mysterious as that of people. It has however, a very different kind of psyche, similar to telepathy or other functions of the human mind which border on the supernatural.

When writing about all these wonders, there is a bewildering array of material available. It is, in fact, hard to know where to begin.

I want to tell you about the most common of our termites or 'white ants'. I am also going to explain how anyone may observe what I have. Indeed, readers may even discover new wonders for themselves. Most of these facts have not been published before, nor even discovered by scientists.

The common termite, which is so destructive to wood of all kinds, and builds 'ant hills' or termitaries on the open *veld* (or bush), is known throughout South Africa. I will tell you a little about the beginning of its community life.

The beginning of a termitary dates from the moment when the termites fly, after rain and usually at dusk, in order to escape their numerous enemies. Even here, we see a remarkable instance of the wonder of instinct. The termites, beginning their thrilling flight, know nothing about enemies. They have never been outside the nest before. The peril of their existence is to them a closed book. Yet nine times out of ten, they don't fly until the birds are safely in their nests.

These flying termites are at least twenty times as big as the others of the nest. They are also quite different in colour and form. A termitary must be seen as a single animal, whose organs have not yet been fused together as in a human being. Some of the termites form the mouth and digestive system, while others take the place of weapons of defence, like claws or horns. In addition, others form the generative organs. These flying termites are the generative organs of the colony. Every one of these winged insects is a potential king or queen. The four beautiful wings have taken months to develop and grow to perfection. Months elapse – or even years in very dry districts – before an opportunity for flight occurs. They will never fly until there has been rain, and the reason is obvious. After the flight, they must seek immediate shelter in the ground. When the ground is hard and dry, this is impossible.

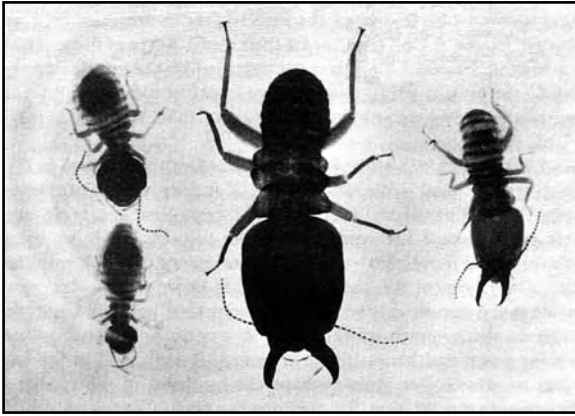
It is interesting to follow the flight of the termites carefully from the moment they emerge from the nest. They crawl out of a little opening, thousand upon thousand. There is obviously much excitement in the termitary. Sometimes the flyers are escorted to the opening by workers and soldiers. The first impulse of the flying insect as it emerges is to try its wings. It flutters and tries to lift itself into the air. If it fails, it climbs a grass stalk and takes off from this height. It is very important to fly though, even if it is only for a few inches. Both flying and protection from its enemies are essential features of this stage of the termite's life.

The object of the flight seems to be to spread the insects over as large an area as possible, just as some plants spread their seed. Some of the termites rise high into the air and travel for miles before they settle. Others sink to the ground, only a step or two from the old nest. No matter what, it is essential that they learn to fly, as it is the sole purpose of their existence.

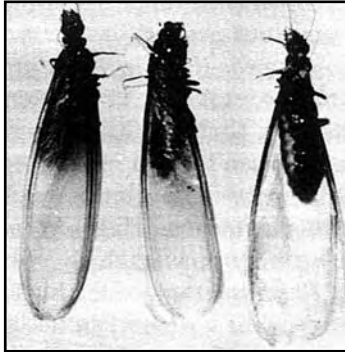
I will describe one of the ants which has flown and settled in the grass nearby. It is impossible to tell the two sexes apart. However, let us take an example and assume it is a female. The first thing she does is to discard her wings. She does this with a lightning-fast movement; it is so fast that we cannot follow it with the eye. One moment we see her with her wings intact, the next moment she steps away, and her four wings are lying on the grass.

It took months for her wings to grow. For years perhaps, she has lived in subterranean darkness, preparing for this one moment. For a period of three seconds, for a distance of perhaps three yards, she enjoyed the exquisite thrill of flight and with that, the object of a great preparation has been fulfilled, and the fairy-like wings are flung aside like a worn-out garment. So her wings are discarded straight away, and she walks about rapidly for a few seconds.

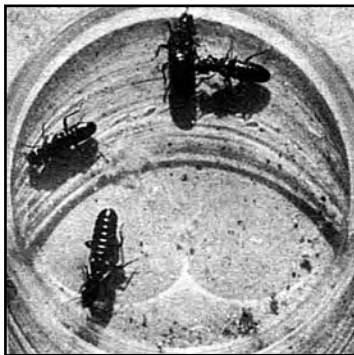
You become aware that she is seeking a suitable place for some further purpose. You are not aware what the purpose



*Soldier and worker termites*



*Winged adult termites*



*Female termites after shedding their wings*

is, and her immediate behaviour does not clear things up for you. You must watch patiently if you want to find out what she intends to do. When she has found a suitable spot, she does something very strange. She comes to rest on her fore-feet and lifts three-quarters of the hind part of her body into the air. She remains stationary in this position, as still as if she were merely the statue of a termite. If you become impatient and walk away, the secret of the flying termite will remain a secret to you forever. What is she doing? She is busy sending a wireless SOS into the air. It is important to stay patient a little longer. There are only a few people who have seen this miracle.

What does the signal consist of? I *think* I know, but I doubt if you will guess what it is. It is only possible to find the clue if you have studied the signals of insects. You may of course think of some sound which cannot be heard by the human ear. You may know of the little South African *toktokkie* beetle (a beetle of the genus *Psammodes*), that knocks in similar circumstances. However, the termite's signal is not a sound. One can prove that by an experiment. For the moment, the fact is that the signal consists of something far beyond our own senses. Yet the male becomes aware of it over incredible distances! How does this happen? Well, it *does* happen, and the female termite's sexuality means that she will make the first advance to a male.

If you wait long enough, you will see another termite come flying through the air, and you will notice that although his flight appears awkward and almost involuntary, he can steer a course and choose a direction, even against the wind. The male sinks to the ground, sometimes a yard or two from the place where the female is standing motionless in her curious posture. As soon as he lands, he makes the same lightning-fast movement which we have already seen in the female, and there on the ground, his wings also lie. His haste is terrible and irresistible. Over and through the grass he crawls, so fast that we can barely follow him with our eyes. He is looking for the

originator of the signal which he received high up in the air. Within a few minutes, he has found her. The female's body has been motionless all the time. Her body has been raised high in the air. However, the instant the male touches her with his antennae, she is affected by his excitement. She begins to run away as fast as her legs will carry her. The male immediately comes behind her. They are now beginning the final search. They are house-hunting, and the male leaves this responsibility to his wife. It must be a good house, for they will live in it for a long time. Soon they have found their new home, and while they are digging the front door, we will leave them for a while.

There are even stranger things connected with this little drama, which the inexperienced observer will not be aware of. I have explained the urge to flight. If those two termites had not flown, none of the events we have watched would have occurred. Instinct is something which only works step-by-step. If you destroy one step or omit it, then the whole system of their community collapses. Nature wishes the 'white ant' to spread. If the nests are too close together it would be bad for the communities. As a result, they receive wings and must fly. However, flight is only one step in their sexual life. If this step is omitted, their sexual life, and their very existence, ends there and then.

For as long as two years, the two sexes may live in the same nest after they have grown wings. They are in constant touch with each other but there is not the least evidence of any sexual life. They *must* crawl out of the nest, they must fly, and must settle and lose their wings. It is only then that their sexual life begins. Once it does, it is immediate. If you prevent them flying and break off the wings, both male and female die. It will be impossible to continue the race.

The length and distance of the flight is of no importance. It may last hours or only a second; it may cover miles or only a few inches. The force which we call 'instinct' means that they



*Termite mounds in Litchfield National Park, N.T., Australia.*

*must* pass through every stage. The termites must take every step, or they are doomed. If you take a male and female just as they are emerging from the nest and place them beside each other, even in the closest contact, you notice that they take not the least interest in each other. They struggle to get away from each other. If the female flies a few inches, the whole process is carried out and finished. If the male circles round even once, and then he is forced to land near the female, it is only then that events will take their normal course. A second in time, three inches in space, one flutter of wings – are to the termite a gulf as wide as infinity, dividing two kinds of existence. To us, it may appear only a small dividing line. However, the insect may not overstep it, not even with human assistance.

# Unsolved Secrets

THERE ARE A LOT OF DETAILS related to the building of the termitary. However, I will focus on behaviour, as it is important to understand for purposes of comparison. All behaviour, both animal and human, is of importance to the psychologist. Behaviour *is* psychology – at least it is all of the psyche we know or can study. For purposes of comparison, for comparative psychology – especially if you begin at the top of the ladder with the apes – the field available for study is in fact, not very large.

The task falls to the king and queen of feeding and attending to the first children. After the children are fully grown, they take it upon themselves to undertake all the work of the community. In the meantime, the queen grows larger and fatter by the hour. Her small neat body vanishes in increasing layers of fat. It becomes an unsightly worm-like bag of fat. To make matters worse, her mate, in addition, has the blessing of appearing to have discovered the secret of eternal youth. He remains as attractive, active and young as he was on his wedding flight. The queen, on the other hand, has become an immovable worm. It is very hard to imagine that that she ever fluttered gracefully as a young termite. It is almost conceivable that the male could cast around for a mate as equally attractive as himself. However, it is to his great credit that he does not behave in this way!

His attachment to his queen seems to keep pace with her own growth. If the palace cavity is opened or attacked by a predator, he rushes round in consternation, but always returns to her side. There is no question of saving his own life in flight. He clings to her gigantic body and tries to defend it. If the attack is sufficiently ruthless, the male termite will choose to die at the side of his queen. This is an outstanding example of the enduring commitment and fidelity of termites.

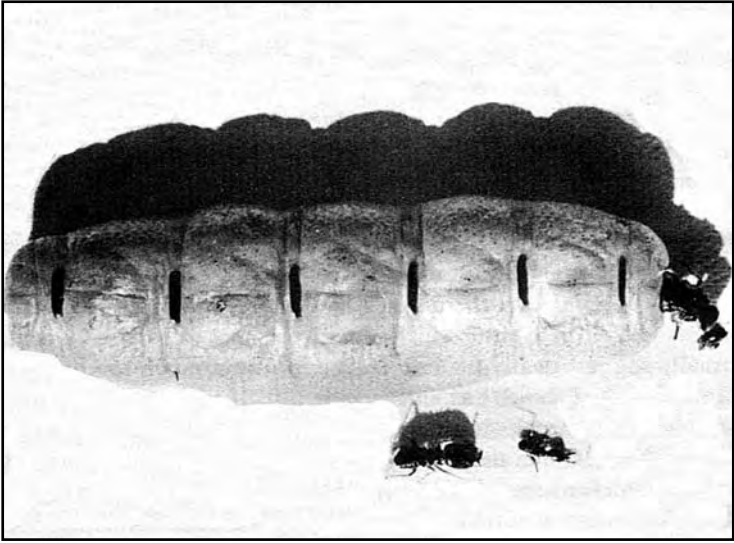
A queen in any kingdom, whether the human or animal world, is often known as 'the mother of her people'. The termite queen quite literally fulfils this role. She is the only mother of the millions which form the community. It is an extraordinary fact that every individual is born from her.

This means that she does not have to take any responsibility for the 'nursery'. All she is expected to do is to keep on laying an endless stream of eggs. This is to counteract the enormous daily loss of workers and soldiers, despite their excellent methods of defence. It is a remarkable feature of termite society that the death of thousands of individuals can be made good by an unending supply.

It is important to note that in actuality, every termitary differs in its growth, but for the purpose of clearly understanding their society, it will be assumed that the environment of our nest has been such that development is entirely normal, and it has not been subject to any disturbing external influences.

The first workers begin to build a palace for the queen. Deep below the surface of the earth, from three to six feet, they prepare a hollow chamber. As years go by, this is gradually increased in size, and the earth which is excavated is taken to the surface, where it is used to form the thick defensive crust. The queen is placed in this hollow chamber. It fits her so well that it would be easy to assume it has been built around her.

In fact, I do not think this actually happens – but at this stage, most of my conclusions are mere guesswork. No human eye has ever seen what actually takes place. No one has ever



*A queen termite full of eggs, with two soldier termites*

discovered a way in which to watch the termites at work in the queen's chamber. They work in pitch darkness, and to let light into the chamber is as great a handicap to the termites as the sudden destruction of the sun would be to us, as we cannot see in complete darkness.

The queen continues growing until, compared with the ordinary termite, she reaches a gigantic size, and becomes an immobile, still mass. The only part of her which gives any sign of life is the little head, which remains unchanged. If you dissect the skin and body carefully and examine it under a microscope, you will be convinced that during her later stages of growth, the queen is unable to make any voluntary movement, except of course of the head.

You may think she could move like some worms do, by contraction and expansion. However, you will find that no part of the body behind the head can be controlled by what was once an intricate central nervous system. I also believe that it is not possible for her to regain the power of movement,

even temporarily. I have not seen any indication of this, even when emptying the sac for a while. Besides, the very nerves in the body have changed into fluid. The theories that the queen is able to move by contraction and expansion, or that she gains a temporary power of movement, have to be discarded.

An examination of the queen's life history shows that her first palace is a cell made of termite earth. This rapidly becomes as hard as cement. Usually she just neatly fits into it. She is always much too huge to use the door of the cell as entrance or exit. If you wish to remove her, you must break down the cell. The king and the workers, however, can come and go quite easily. She is fed and the eggs which she never ceases laying are removed to the breeding grounds by workers appointed to this task. The king apparently does nothing; he appears to be a mere hanger-on in the palace. Still, the queen goes on growing. Here in her first palace, she has not yet attained even one-third of her eventual size. At last, she very nearly fills all the available space in the cell. There is barely room for the tiny workers to carry the eggs away across the inanimate bulk.

A terrible tragedy appears to be imminent. It reminds us of the question: what will happen if an irresistible force meets an immovable mass? The human observer is not in a position to intervene and avert the threat of this terrible fate. Scientific knowledge should not be instrumental in interfering with the way the termite world is constructed.

But termites have never worried about it at all. They have a solution ready – a very simple one. Just before her majesty finally outgrows her cell, they build a second one, half as big again as the first. It is parallel and adjacent to the first, just as hard, and with a narrow door. The queen is then removed and placed in the second cell. There is space for her to grow here for perhaps another year. So she gets transported from cell to cell, until there have been about six changes, with the queen in the last and biggest. The chamber doors are always equally small, much too small for the queen to come or go by.

There is another fact which makes the whole matter even more complicated. One could easily prove by measurement that the queen's subjects could not possibly move her. The lifting power of one termite can be estimated fairly closely, and the area of the queen's body available for workers to grasp during lifting can be measured. During the later stages, it would need thousands more termites to lift her than there is available space for grasping the body.

So we have the following facts:

- The queen is incapable of movement.
- The doors of the cell are too small for her to come or go by.
- The insects cannot lift her.
- Yet she vanishes from one cell, to appear in another.

The only explanation that seems feasible is that there are several queens and that it is not the same one each time. If the first gets too big for her cell, she is killed and eaten, and the workers carry a potential queen into the second cell where she develops into a queen. This seems to be the most reasonable and simple explanation.

Unfortunately, it is not true. The analogy with bees has led to a false conclusion; we have been deceived by the analogy of the bee world, which makes queens, kills, and moves them.

It is quite an easy matter to mark the termite queen, and so prove that it is the same queen which gets moved. I have tested many theories, but have never found one which coincides with all the facts. Perhaps one day, a future Fabre will discover the truth.

# Language in the Insect World

SHORTLY AFTER SHE DISCARDS HER WINGS, the flying queen sends a signal into the air. This is always answered by the appearance of a male flying through the air. What exactly the signal is will now be explained in detail. In order to understand the language of animals, one must first of all learn its ABC. It is also necessary to bear in mind that some previous assumptions about human and animal behaviour need to be re-examined and unlearned. We will therefore begin at the very beginning.

An individual member of any animal race which wishes to communicate with another at a distance can use one of three things: colour, scent or sound. If you think of colour, scent and sound simply in terms of the impression which these make on a human being, then it is not feasible to translate this to the termite world.

There is one kind of termite which constantly signals by means of sound. If you have ever slept in a house in which those termites are at work, you will know the sound well. It is a quick *tik-tik-tik*. You can also hear this if you place a microphone through a hole made into a termitary. You will easily observe that not only do the termites make this noise, but that other termites at a distance hear it and immediately

react to it by their behaviour.

If you catch one or more of the signallers and examine their anatomy under the microscope, what you find is very interesting. There is not the least sign or suggestion of any kind of auditory organ; not even the most primitive kind of ear. There is not even a single nerve that could possibly be sensitive to what we call sound. We find the same regarding colour and scent. The termites undoubtedly use both colour and scent as a means of signaling, yet there is not any organ that resembles an eye. There is not even the faintest spot of pigment which might serve as a primitive eye. The termites are quite blind, yet sensitive to an indirect ray of light far below the threshold of perception of the human eye. That is, they can become aware of a very diffuse light not shining directly on them, which a human eye could not perceive. This can be proved by experiment. As for any organ of smell, that, too, seems to be completely absent.

An observation of another insect, the little *toktokkie* beetle, will greatly help to explain the secret. If you wish to learn to know the *toktokkie* really well and to learn his language, you must tame him. The beetle will become so used to your presence that he won't alter his behaviour, even when conscious of being observed. He is very easy to tame – at least the gray-bellied one with pale legs, not the rough-backed one. He readily learns to accept being captive and studied.

Most South African children are familiar with the *toktokkie* and have heard him make his knocking sound. The beetles are easily located, as you can often see them on the road or beside it. If he does not get a fright and fall down dead with stiff legs, as dead as the deadiest *toktokkie* which ever lived, then you see him knock, and of course hear him, too. He looks round for some hard object, a piece of earth or a stone, and knocks against it with the last segment of his body – three, four, four, three! This is his morse code. He then listens for a moment or two, turning rapidly in many directions. His behaviour is very

like that of a human. His whole body becomes an animated question mark. You can almost hear him saying:

“I’m positive I heard her knock! Where can she be? I hear it again!”

He answers with three hard knocks, and then he takes himself off in great haste and runs a yard or two away. He then repeats the signal in order to get a further true direction, and so he continues until at last he arrives at his partner’s side.

If you study the behaviour of many *toktokkies* during the mating season, you will occasionally have to follow one for an incredible distance in the direction of the answering signal. He can hear the signal over a distance which makes the sound absolutely imperceptible to the human ear. It is at this stage that his behaviour warrants study by a psychologist. If the beetle is studied closely under the microscope, there is still no sign of an ear, or any other complex or nerve which might be linked to sound and hearing. But in spite of this we still think of the behaviour of the *toktokkie* in terms of sound or hearing!

Our version of a laboratory is a stretch of natural *veld* or a fairly large garden where it is possible to study tame *toktokkies*. The observer will soon discover that the *toktokkie* is one of the most credulous of insects. That is, when he is dominated by sexual desire, he will believe everything you happen to tell him. Knock on a stone with your fingernail in his own morse code – and at once he answers. You can teach him quite easily never to knock except in answer to your signal. You can succeed in doing this by not knocking for several days unless he has become perfectly quiet. After a day or two, he will have learnt to knock only in answer to your signal and will answer immediately.

Now get a small, powerful microphone, a headpiece, and three feet of wire (you will find this indispensable in your association with the insect world). The microphone must be so powerful that you are able to hear the footfall of a fly quite easily.

When your *toktokkie* is tame and well trained, it is then possible to test the acuteness of his perceptions. You will discover that they are unbelievably and supernaturally fine.

To continue the experiment, knock on the stone again with your fingernail and gradually make the sound softer until it is quite beyond your own hearing. The *toktokkie* will still continue to immediately answer the signal. Even if you knock with the soft pulp of the finger rather than the nail, so that there does not seem to be any sound at all, still the *toktokkie* answers! Now, take the microphone and place it on the ground with the earphones over your ears. Next, examine its response by knocking on the receiver with the pulp of your finger – a substantial knock, not merely a tap. With a little practice, you can reduce the sound until at last it is inaudible even through the microphone, but still the *toktokkie* hears it!

The solution to the problem is this; it is not sound as such which the *toktokkie* becomes aware of, and there can be no question of *hearing* it. Sound is only our interpretation of certain vibrations in the atmosphere. (Sound cannot travel through a vacuum – you can prove this by sending a sound through a wire inserted in the cork of a thermos flask. It will be imperceptible, except for a faint noise which escapes through the cork.) It is our ear which interprets the vibrations as sound. Beyond the ear, the universe is soundless. Without an ear – or organ of hearing – there can be no sound. But the vibrations which we call sound have a physical function. It is by the exercise of physical force that the drum of the ear and the hammer and anvil bones of the inner ear are set into vibration. In the same way, you can make grains of sand or a thin gas-flame vibrate to a musical note. However, there is another difficulty. The sudden meeting of the surfaces of two physical bodies can result in vibrations of the ether, which are not by any means sound-waves, and therefore have no effect at all on our ears.

We are getting into deep water now. This is where the

study becomes particularly complex and challenging. It would appear that it is vibrations of this kind – waves in the ether, which the ants and the *toktokkie* make use of.

This theory may in fact sound far-fetched, but this explanation links closely to the language of insects. Listen carefully the next time you hear a ‘longbreath locust’ (apparently so called because it is *not* a locust and the sound is *not* made by its breath). In order to fully understand their physiology, it is essential not to think of ‘sound’ or ‘hearing’. Rather, you must think of vibrations, waves in the ether – which can be sensed by another such locust at a distance of at least eight miles. It is also important to understand this concept when examining the communication which takes place between the outlying sections of termite nests.

This serves as a summary and insight into sound in the insect world. There are two other methods of communication: scent and colour.

Termites continually make use of scents, some of which we can also perceive with our olfactory organ. In the Northern Transvaal there is a well-known termite known as the ‘stinking ant’. This creature emits a foul smell to a distance of three or four yards, which has the peculiar property of causing extreme nausea in most people and also in dogs. Then again, all South Africans will be familiar with the characteristic smell of the common termite. This is caused by the discharge of a gas. It is of the utmost importance in the study of termite language to fully understand what the signal of the queen really consists of. After a long period of study, I have come to the conclusion that it consists of something which would affect our senses as *scent* if it were strong enough.

Things always seem pretty hopeless in the beginning when we are dealing with phenomena which lie far beyond our senses, but ‘perseverance pays’ must be the motto of the traveller along these dark and unknown pathways.

There is another reason for thinking that the signal may be

thought of as scent. You can easily train a pointer to track down the flying termites after they have lost their wings. He will track down a signalling queen for nearly a hundred yards against the wind; with the males, he finds it difficult even over the distance of a yard. But a still more important proof will take me longer to explain.

The following are all the signals used by the termite:

- 1) *The communal signal*, which is constantly sent out by the queen, who forms the hub of the nest. This serves to keep the community together and enables every termite to recognize every other member of the community. It is a signal which cannot be perceived by our senses.
- 2) *The call of the workers and soldiers*. This is perceived by us as sound.
- 3) *Food messages*. (Beyond our perception.)

These three be will examined more closely later on.

- 4) Lastly, *the sexual signal of the queen*, which is also beyond the reach of our senses.

Throughout nature, scent and colour are used as sexual signals. If there are no brilliant colours, you can be sure that there will be some scent instead.

Allow me to digress for a moment. We have seen how the flight of the termite is the key to which the door to their sexual life is unlocked. Without flight, there can be *no* sexual life. It is simply not possible. I will give another insight. In mammals, the key to their sexual activity is generally *scent*, which may also be allied to colour. This begins in the plant world. The colour and perfume of flowers is of course, purely a sexual phenomenon. In mammals however, scent still remains as the key to attraction, and therefore survival. It is this which makes sexual life possible.

That is why it is possible to keep large mammals for years in

a zoo or a menagerie without their sexual urge being activated. It is interesting to study African kudu in relation to this fact. In the Waterberg, I often had the opportunity to closely observe a wonderful sight. For a week or two every year, the kudu cows become scented or 'on heat'. As soon as this passes, the bulls leave the cows and segregate themselves to graze in small herds. Of course they come in contact with the cows occasionally, but never show the slightest interest.

However, when the cows are in heat again, the scent will travel four or five miles on the wind. Prior to this, the bulls were grazing peacefully. Once they get the scent on the wind, it is as if they have been hit by a thunderbolt. They immediately become restless and they eagerly sniff the wind. The whole herd, which a moment before was grazing so peacefully, responds with deafening bellows. They are then lost in a cloud of dust. The only sound now is the clashing of horns and bellowing of rage. Their sexual life is always preceded by the stimulation of the fighting sense. Without the special scent from the cows, their sexuality would not have been stimulated.

This can be easily proved. Take one of the smaller mammals; the kind dependent on the sense of smell. If its olfactory nerves are destroyed or cut by incision (in some cases nature does this with an ulcer), he will never again be sexually stimulated. This is the case even if a male comes into very close contact with a female, including one in heat. External stimulation, in the form of scent or colour, is always essential to stir their sexual interest. The only animals whose sexual interest can be aroused without this outside stimulation are the higher apes and people. In the instance of the ape and humans, the cultivation of scent and colour is both fascinating and mysterious.

It is very interesting to gain an insight into why some women choose to wear perfume. There is in fact, a subconscious reason. The attraction of wearing perfume is linked to a forgotten instinct from the ancient history of our race. The basis of all perfumes is the sexual secretions of several kinds of cats,

of deer, and (the most expensive of all), the essential sexual material secreted by a certain kind of whale. These scents are today artificially produced for the perfume industry. Musk is the universal basis of the scent sex signals in animals. Even in humans, this phenomenon may still be found. Indeed, about one woman in every thousand still secretes musk on occasion. As a result, her skin becomes strongly and exquisitely fragrant. As in the case with many such primitive characteristics, this secretion of musk is found more frequently in the monkeys or apes. Nevertheless, that is the origin of the role of scent in sexual attraction. In the primate world, it still plays a significant role.

Scent may also be regarded as waves in the ether, or space. It is false to assume that perfumes consist of gases or microscopic substances. Perfume itself is not entirely a physical substance. You may scent a large room for ten years with a small piece of musk and yet there will not be any loss in its weight.

This has been a way of illustrating what the signal of the queen really consists of. It has provided an insight into the sexual signal of the termite queen. It is actually a wave circle in the ether which our olfactory nerves would perceive as perfume – that is, if our senses were even aware of it.

# What is the Psyche?

**T**HAT WHICH IS KNOWN as the psyche or soul is something far beyond the reach of our senses. No one has ever seen or smelt, or heard or tasted or felt the psyche, or even a piece of it.

There are two ways in which we can begin to track down the psyche.

In my own innermost self, I become aware of something which is not a tangible part of my physical body. This awareness of course is limited to a part of my own psyche. That of my brother is just as far beyond my direct reach as is the psyche of the termite. I must accept the existence of other psyches because I am told of them. Introspection is thus one method by which I am able to affirm the existence of the psyche. But this is a separate branch of knowledge which at the moment does not concern us.

Now we come to a question which will prove more interesting to us in regard to our observation of the termite. I will try again to be as sparing as possible in my use of scientific technicalities. But I must enlarge on it, and you must be patient and try to understand it if you wish to grasp all the wonders of a termite nest which will be revealed to you later on.

Remember that most of the important definitions which follow are my own, and made on my own responsibility, for what that may be worth. You will search scientific books in vain for confirmation of what I say. Nevertheless I flatter myself

that if you really study nature, not only will you find that all I say is true, but that it is the *only* key with which to unlock many dark secrets in the behaviour of living creatures.

Let us first see what science says. The psyche, so say scientific and very logical people, *is a state of matter*. This was also their first definition of magnetism; you dare not say the psyche is something which causes a certain state of matter, for there is no proof of that. But the analogy with magnetism and later discoveries gives us a certain right to say:

*First*: “The psyche is something outside the reach of our senses; it causes certain states in matter, which states are within the reach of our senses.”

It is of course only through movement that we can become aware of this state. This raises the question: what is a psychological movement? Our whole life is a world of movement. We see dust and leaves blowing about in the wind; we see streams flowing and water plants swaying in it. We hear the wind and feel it; we see a little ant carrying a piece of food to its nest, we see an egg apparently unmoving, but if we have the chance of watching it long enough and carefully enough, we see a continuous movement, which eventually results in a chicken. Which of all these movements are movements of the psyche and which are not? While avoiding a deep analysis of logic and metaphysics, it is still possible to state that only movement which has a definite motive can be a ‘psychological movement’.

*Secondly*: Our own psyche is naturally the criterion which enables us to establish whether there is a motive or not.

Logically, this may not be an entirely satisfactory definition, but for the practical naturalist it is sufficient. Secondly, we learn by experience that such movement occurs only in certain kinds of matter – namely organic; that it mostly originates in the organism itself, and is not dependent on forces outside itself. The key word is *mostly*, because there are many motivations in nature which are really dependent on outside forces and yet

are psychological movements.

There is the case of the seed of what we call the 'flute reed'. Like a little powder-puff in shape, the seed floats on the lightest breeze like a tiny plane, but as soon as it arrives over a pond or a marsh, the seed sinks to the ground like a bird settling on the water or damp ground. At first sight, this appears to be a truly psychologically motivated movement coming from within the seed, such as we very seldom find in the plant world.

On closer examination, the explanation is that through friction with the wind, the little powder-puff, before it wrenches itself free from the mother stem, receives a charge of negative electricity. The result is that all the fine hairs of the puff spring apart. As long as the hairs are spread open, the seed floats in the air; but as soon as it comes into contact with water vapour, the electricity is discharged and the puff folds up and slowly sinks to earth. By this means, the plant makes certain not only that its seed shall be spread far, but, what is of greater importance, that every seed will land on damp ground or actually in water. Here you have a number of objectives which the plant achieves by utilizing natural forces outside itself. Nevertheless, all these fall inside our definition as movements *with a motive* and therefore, psychological.

*Thirdly:* Mostly – but only mostly – the movement originates in the organism itself.

The above definition will suffice for the practical naturalist. He will at times come across some puzzles, as for instance the pretended death of the *toktokkie* or the growth of a crystal; but after reflection he will find our definition still suffices.

A few words more about our classification of these motivated movements in nature, and then we will have finished this dry-as-dust topic and can continue with our termites. That all this has been very necessary, you will see later.

To sum up, these 'motivated movements in nature' have been classified as follows:

1) *Motivated movements in the plant world.*

These consist of four kinds:

- a) Growth (for instance turning towards the light by plants).
- b) Tropism. Induced by outside influences.
- c) Movements dependent on natural forces outside the organism.
- d) Movements which appear to originate from within the organism, for instance the extension of tendrils towards near objects by certain creepers; this may also be a tropism.

2) *Motivated movements in the lower animal world.*

The most common and most important are movements which originate in the organism itself. External forces of nature are used, but in a manner differing to that of the plants. The peculiarity of these movements is that they always follow a fixed course; the organism can never modify or change its behaviour; and this fixed behaviour is as much inherited as the organs of the body.

It is therefore possible to conclude that all motivated movements are dependent on what we call *memory*. We call these predetermined inherited motivated movements 'instinct'. This is especially evident in its original form in insects. Throughout the whole lower animal world this is unchanged until you come to the apes and humans. It is only then that you find a vast and striking change in motivated movements, both in quality and in quantity.

It is important to establish the role and relevance of the psychology of instinct. The memory which constitutes this instinct is hereditary, in the same way that the physical organs of the organism are hereditary. The following experiment which I carried out will explain what I mean.

The well-known yellow South African weaver bird – there are many kinds, but any kind may be used for this experiment – plaits a wonderful little nest at the extreme tip of a flexible branch, generally over water. You often see their nests at the end of the thin drooping twigs of the graceful weeping willow, but have you ever taken the trouble of watching to discover how the very first piece of grass is tied to the twig and what kind of knot the little bird uses? The full-grown bird is a seed eater, but the little ones are fed on worms until it is nearly time for them to leave the nest. Remember these two instinctive memories:

- 1) How to build the nest, and
- 2) How to feed the fledglings.

I hatched the eggs of the yellow weaver under canaries for four generations. The new birds were forced to lay eggs each time without being able to build their characteristic nest. This is the most difficult part of the experiment, but it can be done. Every time these eggs were hatched under canaries, the young ones were fed on a synthetic diet and were never allowed to see a worm or an insect. Nor did they ever see a piece of grass which might be utilized for building. Then I took this fourth generation and provided them with everything which they would need in their normal environment. Remember now, that for four generations they have not seen a plaited nest or tasted a worm. From personal experience, the bird cannot possibly know what to do. There can be no question of individual memory. I expected at least that there would occur some deviation from normal behaviour, but it was not so. When the time arrived for nesting, the birds began plaiting vigorously. They made more nests than they required. This often happens in nature as a means of protection. The eggs were hatched and the young ones were fed on worms!

This experiment shows what I mean by the inherited memory of instinct.

The second characteristic of this psyche is that the individual is incapable of deviation from a certain fixed way of behaving. In other words, he cannot acquire any individual causal memory. Inherited memories are a key characteristic of all behaviour. Even when death threatens, there is no escape. This remains the case even if escape means behaviour contrary to the inherited memory.

Here are two further examples to support this. The black 'road-maker' ants – real ants this time, not termites – are found in many parts of South Africa. They make footpaths, hundreds of yards long at times, along which they bear all kinds of plant and grass seed to their nest. At a distance, you see two streams of these ants, one apparently white, the other black. The approaching ants each carry a white seed; while the retreating ants don't carry anything. The ant carries the seed in its husk down into the nest. Here the husk is carefully removed. The seed is stored, and the husk is deposited outside the nest in a heap. One kind of 'road-maker' ant is a master of a wonderful natural secret which even scientists have not discovered. It knows how to prevent the germination of seed, even when this is placed in damp ground in the dark. The microscope cannot even discover the least flaw in such seed. However, if you pick some of the same seed and place it in exactly the same spot where the ant places his, it germinates within a few hours. These 'roadmakers' are afraid of water. A flood is their greatest natural enemy. This is because they were originally a desert ant; in other words, they are emigrants, and have not yet learnt how to protect their subterranean nest against long continuous rains.

The fear of this arch-enemy of their race is deeply rooted in them. The only solution they have is flight – as early and as far as possible.

If you dig a little furrow across their path and fill it with water, the ants become very confused. On both sides of the furrow, an excited group will congregate. It takes them a very,

very long time to discover that an easy solution would be to make a detour. Before they think of this, however, a grass stalk may be placed across the waterway to serve as a bridge. You will immediately be able to watch their very peculiar and mysterious behaviour. The ants begin to test the dangerous bridge. One by one, they try the bridge with their forelegs, stretching their bodies across it, while they cling to the bank with their back legs. They feel the bridge with their forelegs and antennae. They then become aware of the water and hastily retreat to tell their fellow ants that the bridge is quite unsafe. This is what happens on the bank which is on the same side as the nest, where the unladen ants congregate. On the other side of the bridge, the side farthest from the nest, the behaviour of the ants is quite different. The ants arrive here, each laden with a grass seed. Generally, the seed is so heavy that the ant's progress is both difficult and hindered. What happens at the bridge? With apparently not the least hesitation, each ant steps on to the straw with its gigantic burden. Sometimes it capsizes, but clings to the bridge with all its legs, and still manages to cross. It always succeeds in bringing its load to safety and hurries home to its nest as though nothing had happened.

This is where their behavior becomes puzzling. The unladen ant is afraid to risk its life on the bridge while the laden ant crosses with a load which makes its passage a hundred times more dangerous. The carrying of the burden cannot possibly lessen its awareness of the water.

Take a square piece of tin covered with earth, and push it under the ants congregated on the nestward side of the bridge. Once they are gathered thickly on the tin, pick it up. With a fine brush, mark as many ants as possible with a small red mark on the hind part of the body, and then shake them on to the ground beyond the bridge. Immediately you will observe that they all rush off along the path, shortly to return each carrying a grass seed. The ants will then cross the bridge without any hesitation, as if they had been crossing bridges all their lives.

After a while, some of the marked ants will return from the nest, having safely deposited the seed. When they come to the bridge they stop, and nothing you can do will give one single ant the courage to cross the bridge. You may continue this process until almost every ant is marked with a red spot. In the end, you will have learnt two things:

First, that you will never teach the ants by their own experience that the bridge can be crossed in safety. Secondly, you will never teach the ants that if the bridge is safe for a heavily laden ant it must be, proportional to the load, so much safer for an unladen ant. They prove this for themselves hundreds of times. If you were to continue this experiment for months, the ants would be able to prove this fact thousands of times. Their behaviour never changes or varies, thus reinforcing your observation of their innate behaviour. The unladen ant will never dare to cross the bridge, but as soon as he returns with his heavy burden, he crosses without hesitation.

Can you guess why the unladen ant refuses to cross and the laden ant does not? If you have investigated the psychology of animals, and therefore, the behaviour of the ants, it shows that their motivation is to obtain food. The behaviour of the unladen ant which leaves the nest is determined by only one instinctive urge – to fetch food. In any case, it is not a very strong urge, for it always operates in opposition to the ever-present and very great urge – *the homing instinct*. This is the strongest of all psychological urges, except the sexual urge. Higher up the scale of animal life, we call this urge “homesickness”, *heimweh*. The ants returning with the seed are drawn by two of the strongest urges:

- 1) *The homing instinct*, and
- 2) *Bringing the food to safety*.

It is as if you had tied threads to the ants and were pulling them. The thread pulling the ant away from the nest is very weak. When the ants become aware of danger and become

afraid, the thread breaks. But the returning ants are drawn by *two* strong threads, which even fear of death cannot break. It is therefore evident that there is a plausible explanation for the apparent mystery surrounding their behaviour.

It is now possible to understand what is meant when psychologists state that the instinctive psyche cannot deviate from the inherited formula of behaviour, and that no individual can acquire a causal memory – in other words, he cannot learn by his own experience.

I also said that the psyche of inherited memories is a force which cannot be turned aside even by death, if escape means behaviour which conflicts with the race memory. As an example of this, I will describe the case of the springboks on the Springbokvlakte in Waterberg. This *vlakte* or plain is an island of open *veld* in the middle of the Transvaal *bushveld*. The springbok is highly specialized for life on the open plain, in other words all his inherited memory is of open plains. He knows how to escape the perils which threaten him there; he knows which is the best food for him there and how he can find this. In addition, he knows when and how to change his environment. He can see and smell over great distances. On this plain in the 1920s, there were thousands of springboks. They have now been exterminated. Slowly but surely people have populated this area by creating farms, fencing off camps, and destroying the springboks. To the west, the mountains rose and to the north lay the endless bushveld, where they would have been absolutely safe. Death lay on the one hand and safety on the other, but they could not take the step which would have saved them. Thousands of other big game, less specialized in their behaviour, fled into the bush and saved themselves from extinction. It often happened that herds of springbok were chased by hunters into the *bushveld*. They always returned, however – sometimes the very same day – to meet death on the open plain.

There still remain two further kinds of ‘soul movements’ or

instinctive urges in nature, the classification and peculiarities of which you must know if you hope to understand even a little about the behaviour of the termite.

- 3) *Group movements.* There are some movements in individuals of a community which are determined by some purpose of benefit to the community. We term this phenomenon the “group psyche or soul”. You find it in the termites, ants, baboons, apes, and in all animals which live in groups or are gregarious.

Then lastly:

- 4) *The psyche of individual memory* – that is the psyche of the primate, man and the apes, baboons and monkeys.

When you live with baboons, you soon see that the difference between the psyche of the lowest baboon and the highest mammal (the dog or otter, for instance), is far greater than the difference between the psyche of the baboon and that of man.

What exactly is the difference? We know that the difference is there, but it requires considerable research to understand what it is.

If you ask scientists what the psychological difference is between a baboon and an otter, nine out of ten will say that the baboon possesses powers of reasoning and intelligence which the otter lacks. It would be just as clear if they said the baboon is a baboon and the otter is an otter. Neither answer takes you very far. Another scientist may say that a baboon can learn new habits more easily than an otter. This provides more of an insight but is not a comprehensive explanation.

It is necessary to carefully examine the issue of race memory. This allows us to see the result of it in nature. An example is a land bird that can fly and is very much the same in every respect as other land birds. Gradually our bird begins finding

food on the beach. After millions of years, it learns to catch fish in fairly deep water. As soon as this becomes a fixed habit, natural selection begins to operate. The deeper the bird goes into the water, the more chance it will have of survival if it is equipped for this new life, both physically and psychologically. This process of evolution continues for another million years. The bird loses its wings, which now serve as oars; it loses its feathers, which become down; the legs become adapted for swimming – and at last we have the penguin. By the way, you will see I adhere to Darwin's theories: I never saw very much in those of De Vries.

If we observe the penguin or the otter, despite their differences, several important facts are evident. If any sudden change occurs in their environment, they are completely at sea. An example of the otter in these conditions was during a drought once in the Waterberg. It lasted for four years and when all the streams became stagnant, you would find otters all over the *veld* adjacent to the big waterways. There were still pools of water, but these did not contain any fish or crabs. The otter is nimble, and you can teach it to catch birds and other small land animals in the same way a cat does. Yet the otter cannot teach itself to do this. Hundreds of these wild otters died in the midst of plenty. At this time, I managed to get hold of a pair of newborn otters. One of these I sent to Springbokvlakte, thirty miles from the nearest running water. As he was dug out of the nest shortly after birth, he had never seen a river. A bitch reared him with her own litter. He never saw or was given food other than raw meat, birds and other land animals, and he never saw water, except when it was given to him in a dish to quench his thirst.

At the same time, I took a newborn baboon from the mountains to the plain and reared him with a feeding-bottle. Afterwards he was fed on food which was not his natural diet. No opportunity was given him to catch or eat a living insect. When both these animals were three years old, they

were taken for the first time to their own natural environments. The otter was taken to Sterk river, its original environment, while the baboon was taken to the Dubbele Mountains where his mother had been shot. Both were starved for a short while prior to this. This created a wonderful opportunity to observe the great difference in the behaviour of these two creatures.

On being released, the otter hesitated for just a moment or two, then plunged into the water, and within half an hour had caught a crab and a large carp and devoured them on the rocks.

The baboon, on the contrary, was completely lost. He was in the midst of a source of natural food yet, although starving, he obviously knew nothing of turning over stones and catching the living insects which hide beneath them. There is no doubt he would have died of hunger if he had been left alone. When I turned up a stone for him, he retreated from the wriggling insects, and showed signs of fear and horror. With the greatest difficulty, I succeeded in persuading him to taste a dead scorpion, from which I had removed the sting and the poison gland. At last, he was induced to catch a living one, with the result that he was immediately stung on the finger. He chose, amongst other things, to eat a wild mountain fruit that is deadly poison, and his life had to be saved. Such accidents never happen to wild baboons. They have learnt. Our tame baboon also eventually understood all these things, but he had to learn by painful experience.

We see then that nature has done two things for the baboon: a psyche has been provided which is able to acquire individual causal memories; and secondly, nature has done away with his inherited race memory. The baboon is the transition point in the animal world. He has advanced so far that in about fifty per cent of cases, there is no inherited orientation of the sexual instinct, the instinct which is the strongest inherited instinct of all. In humanity, we find no inherited orientation of this instinct at all. Sexual desire may awaken, but the orientation

must be learnt in both sexes. How has this extraordinary change in natural behaviour taken place? In the first place, some great advantage must accumulate for the race as a result of the change.

On the whole, the result of inherited memory is to bind a race to a special environment. The penguin to the sea, the klipspringer to the mountains, the springbok to the plains. The more perfect race memory is, the more strictly confined the organism will be to its environment. This is the result of natural selection. The affirmation or belief that selection and development in nature are striving after some ideal state of perfection is incorrect. In every case of highly specialized animals, a *loss* of physical perfection has occurred. An exchange in terms of natural selection always takes place, but the the result is not perfect. When the penguin exchanged his wings for oars, it did not become more perfect; the long neck of the giraffe is a disadvantage in flight. Nature is not a 'charitable institution'. In fact, the environment is inevitably challenging, if not hostile. If this was not the case, there would be no natural selection. It is clear, too, that the species which is bound too closely to a certain environment is at a great disadvantage. If the environment undergoes a sudden change, such a species is lost. It cannot change to a new environment and individuals cannot acquire new memories to enable them to cope with the changes in their environment.

In Africa, it frequently happens that whole species are exterminated by such changes in nature as droughts, locusts, or the arrival of other unknown enemies. To give a species the great advantage of being able to change its environment suddenly, natural selection must cause a change in the very psyche of the animal in question. No single or even repeated physical change can bring this about by itself. There must be psychological change too. The first and most important step is to wipe out the inherited or race memory. Unless this happens, there can be no change in environment. Not only must the

race memory be destroyed, but even the possibility of its being inherited must disappear from the psyche – or the change will be useless. Instead of race memory, a psyche must be developed which enables every individual to acquire his or her own causal memory of their environment. It is this change in the baboons which has given them an advantage. Everyone who is familiar with them will acknowledge that this is the case.

The immediate result of this change was to make the baboon a 'citizen of the world'. It can adapt itself to any environment – that is why we find South African baboons in a variety of surroundings. You find them on the fruitful mountains of the Cape, in the big forests and river valleys of the interior, and in the waterless deserts of the Kalahari. In every environment, the baboon acquired new habits. It learnt to catch suckling lambs and tear them open in order to drink the milk in their bellies – throughout half of South Africa. In the Northern Transvaal, the baboon has not learnt this yet. In one district in Waterberg, the baboon has learnt to place a hard fruit on a rock and break it open with a stone. This is evidence of the first use of an implement. Nowhere else in nature will you find such behaviour, except in the baboons and apes.

From all this investigation, we can derive two clear facts. First, there is a vast psychological gulf between the psyche of the baboon and the psyche of the highest mammal below the race of primates. Secondly, the psyche of humans and the psyche of the baboon are exactly the same in quality. The difference is found to be only in quantity.

In the case of the baboon, we are looking at the stream near its source in the mountains. In the case of the human race, we see the same river just before it disappears into the ocean.

Humanity has gone the furthest in this direction. That is the reason why people have conquered the biggest and driest deserts, the Gobi and the Sahara, the highest mountains, the deepest valleys, the tropics and the frozen Poles – and survived. However, the environment extracts a price in return. As has

been shown, there is always an exchange. The baboon and the human race paid a high price for their new type of psyche. This price may be so high, that it is bound, surely but slowly, to bring about their natural extermination.

The old animal psyche of race memory does not actually get destroyed. Instead, it is paralysed by a kind of permanent inhibition. It still remains however, and can be artificially stimulated into functioning. This is the greatest discovery I made during an observation of the wild baboon lasting over three years. The so-called 'subconscious' psyche of humanity is not a creation of natural selection which leads to ideal perfection, but is in fact the old animal psyche in a state of inhibition. That is, the instinctive, natural behaviour has been suppressed or altered. In abnormal circumstances, this is released and leads to serious psychological disorders.

This background has been presented to allow a further investigation of the communal psyche of the termite.

# Luminosity in the Animal Kingdom

THE ORDINARY USE OF LIGHT by the glow-worm and firefly is well known to South Africans. In the Transvaal, the fireflies create an amazing show. On the slopes of the Highveld, they appear at times in such numbers that the riverbeds stretch into the night like streams of light as far as the eye can see. It is difficult however, to know for certain what the motive of this signal is. Despite long, careful observation, it was impossible to see the purpose, if there was one, of the signal. It almost seems as though the insect purposely hides its motive when it becomes aware of being observed.

In this respect, the firefly reminds me of the pollination of one of our grasses, *aristida*. This pollination is very challenging to observe. I remember how I watched one whole day until after midnight at the side of an unpollinated plant. At night, acetylene mine lamps were lit which cast a circle of light as clear as day for nearly a hundred yards round the plant. I went to sleep for a couple of hours and woke to find that the pollination had taken place while I slept. The pollination takes place when you least expect it, an hour or two before daybreak. I also spent many sleepless nights watching the firefly and was still not able to determine what the motive of the signal could be, except possibly that it is a sexual signal. If there is a doubt, it arises from the fact that the sexes are not dependent only on

the light for their sexual life. There are other land creatures which also periodically become luminous.

The most fascinating is the large green centipede which is found in tropical parts of Africa. Perhaps this gigantic centipede causes more fear and horror in people unused to handling such creatures than any other. For some reason – which I do not know – this monster sometimes becomes luminous. It is a rare occurrence and I have only seen it twice. The spectacle is one you will never forget and if you encounter it unexpectedly in the dark, it is quite extraordinary. The centipede is about twelve inches long and while the luminosity lasts, the creature, which is usually so quick, appears to be in a state of cataleptic paralysis. It appears as though all its energy is being used for the generation of the brilliant light. So bright is the illumination that fine print can easily be read in a dark room at a distance of two feet. It is difficult to determine what causes the light. A chemist examined all the organs of one of these luminous centipedes and he could find no trace of any known light-giving element. Under the microscope, the light appeared to come from two luminous patches near the ends of each segment of the body. The light is in continuous movement, an irregular glowing and paling. This expands and contracts in concentric circles, coming from an intense centre of white light. The circles of light are independent of each other. Coincident with the change in intensity, there is a constant, amazing change in the colours of the circles of light. Passing outwards from the white centre, the colours appear in the following order: light-yellow, light-green, emerald-green, dark-green, blue, dark-blue, red, purple and violet. The source of the light lies within the body of the insect and is irradiated through the skin. In the glow-worm, the source of the light appears to be outside the skin.

This is yet another example of the unexplored field of work in connection with the signals of animals. The characteristic of luminosity completes the list of animal signals. Similarly,

the firefly too, still has elements of mystery.

What is the motive of the light and what *is* the actual light? These puzzling elements often remain when we study animals which make use of well-known forces of nature.

The South African jellyfish, for example, has as a means of defence a charge of electricity, with which it shocks you if it touches you under the water. The whole of the body of the jellyfish is filled with water. This forms a perfect conductor without insulation, as it is surrounded by sea-water, which is a far better conductor than the human body. In such conditions, it appears impossible for the creature to generate a charge of electricity, and still more impossible to direct it through human skin. The creature simply *cannot* do it – yet it does!

In the discussion of fireflies and glow-worms, it is important to question one theory. The famous Fabre died under the firm impression that he had discovered the secret of the light. On the skin of the insect, we find a white powder, which looks very much like frost. The insect projects on to this two streams of air, and the light disappears in the absence of oxygen. Fabre therefore concluded that the phenomenon was nothing other than oxidation. He had no further doubts and his statement has been repeated by many writers.

However, if it *is* oxidation, then it is a form of oxidation which is found nowhere else in nature, and which the cleverest chemist could not imitate – as this would require a complete revision of all our beliefs about the properties of oxygen.

Oxidation always generates heat, even if it takes place very slowly, as for instance in the rusting of metal. The heat is then generated so slowly that it is not noticed, but still there is heat. If oxidation takes place rapidly, the generation of heat becomes explosive. When oxidation takes place quickly enough to cause light, there must be a previous and continuous generation of heat. Oxidation without this phenomenon is just as impossible as fire without light or heat. If oxygen is necessary for the firefly's light, that does not prove that the light is due to

oxidation, as Fabre claimed. If you take several fireflies and test them with a sensitive thermometer, you will find there is no rise in temperature due to the light. One could prove that to produce a light equal in strength to that of the firefly for one hour, the bodies of more than eighteen hundred fireflies would have to be burnt. I would conclude, based on this evidence, that Fabre's theory is wrong.

There is further information that it is necessary to understand about the qualities of light. Some years ago, a Japanese naturalist discovered that the firefly emits rays which affect a photographic plate through the black covering. These rays must be those which are imperceptible to the human eye. I have been unable to test this myself, or to discover whether our fireflies also emit these rays.